FOR210

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Carbon Sequestration and Storage by Gainesville's Urban Forest[1]

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Climate change is a world-wide issue, and it may seem as if only actions by national governments can work effectively against it. In fact individuals and small communities, too, can make wise choices and impacts. Communities can mitigate climate change through reducing fossil fuel consumption and good management of its urban forest. Urban trees can reduce concentrations of atmospheric carbon dioxide by storing carbon in their roots, stems, and branches. Urban forests can also help reduce carbon dioxide emissions from fossil-fuel-based power plants because their shade and wind protection reduces energy consumption for heating and cooling buildings. By estimating the amount of carbon removed by trees, we can determine the role of urban forests in mitigating climate change and also assign an economic value to the amount of carbon sequestered by an urban forest.

Using the USDA Forest Service's Urban Forest Effects (UFORE) model (http://www.ufore.org), researchers at UF/IFAS's School of Forest Resources and Conservation and the USDA Forest Service estimated carbon storage and sequestration by urban trees in Gainesville, Florida. Carbon storage is the estimated total amount of woody biomass held in a tree's stem and branches over its life. Carbon sequestration is the estimated amount of carbon a tree's stem and branches take up during one year of growth. Carbon in the below-ground roots of a tree was not accounted for. In 2006, the researchers collected data from 93, one-tenth-acre field plots located randomly across the city of Gainesville. The model uses tree species equations to estimate tree dry weight from stem diameter. Approximately 50% of a tree's dry weight biomass is carbon; the researchers estimated the dry weight and then divided by two in order to arrive at an estimate of the amount of carbon stored in Gainesville's trees. In estimating carbon sequestration, researchers accounted for average annual growth for different types of trees in different size classes and in different conditions (Nowak and others 2002). Since carbon value is traded in carbon offset markets in units of carbon dioxide, carbon estimates were then converted to carbon dioxide (CO_2) equivalents. Values were multiplied by $4 per metric ton (mt) CO_2 equivalent and the current market value (August 2008) on the Chicago Climate Exchange (2008).

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Table 1. Comparison of Average Carbon Stored and Sequestered per Tree by Diameter at Breast Height (DBH) Size Classes in Gainesville, Fl.

DBH Class [1](cm)	Per Tree C Storage (kg)*	Per Tree C Sequestered (kg/year)
1 – 15	22	2
16 – 30	192	9
31 – 45	658	17
46 – 60	1349	9
61 – 76	2812	33
77+	8858	111

From: Escobedo and Zipperer. 2007. *1 kg = 2.2 lbs

Table 1 compares the average amount of carbon stored and sequestered per tree by different size classes. Large trees greater than 77 centimeters in diameter at breast height (dbh) sequester the most carbon in Gainesville. Overall healthier and larger trees sequester more carbon annually than do younger trees with a small dbh due to the limited growth and size. Eventually if small trees remain healthy and continue to grow, they will accumulate more carbon as their biomass increases. Trees in poor condition sequester less carbon than do healthy trees, and dead trees actually emit carbon as they decompose.

Since carbon is valued in terms of CO_2 equivalents, C results were converted to CO_2 by multiplying by 3.67. Figure 1 depicts a comparison of the economic value and CO_2 stored by trees located in different land-use areas in Gainesville. Trees in residential and forested areas store more CO_2 than trees in commercial or industrial areas simply because more of Gainesville is devoted to residential use and to forests than is devoted to commercial and industrial uses. However, by analyzing on a per-hectare basis, 1 hectare of forest and forested vacant land use can sequester 5-6 mt of CO_2 per year while residential and commercial areas in 1 year sequester 4 and 1 mt CO_2 per hectare, respectively.

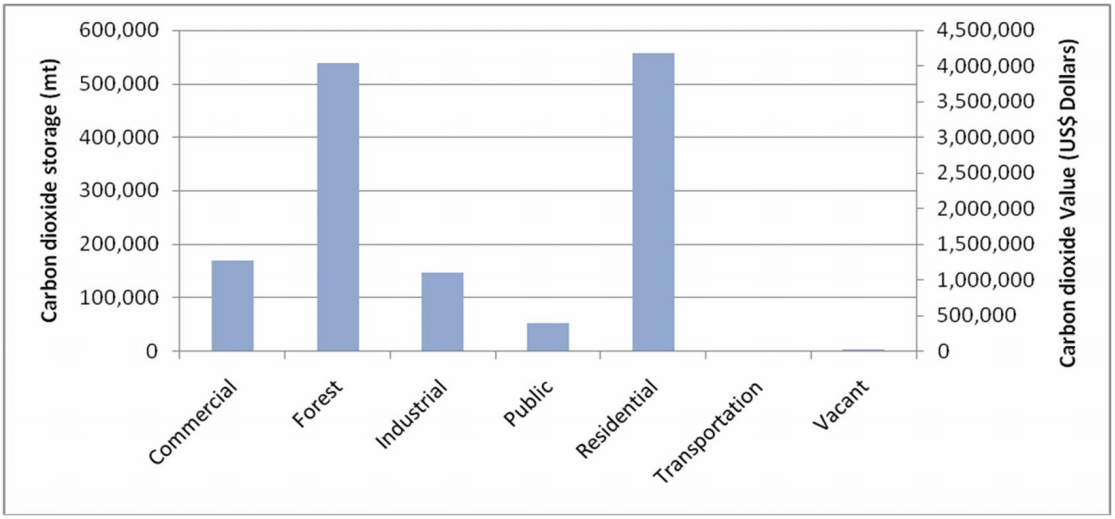

Figure 1. Net carbon sequestered per land use area and the associated value in Gainesville's urban forest. Escobedo and Zipperer. 2007.

As trees grow, they store more CO_2 by assimilating it in their woody tissue. Conversely, as they die and decompose, they release much of the stored CO_2 back into the atmosphere. Thus, CO_2 sequestration can be negative if there are more dead than live trees (if more CO_2 is being emitted by decomposing trees than is being sequestered by healthy, growing trees). Dead and decomposing trees in Gainesville emitted approximately 3,500 mt CO_2 in the study year. Accounting for this loss, CO_2 sequestration by trees is about 9,740 mt CO2 per year with a value of $38,954.

The 10 tree species in the city that sequester the most CO_2 are illustrated in Figure 2. Of all the species sampled, laurel oak (*Quercus laurifolia*) sequesters the most carbon dioxide or about 16% of the total CO_2 sequestered. This is because laurel oaks are more abundant in Gainesville than other trees including live oaks and tupelos. Live oaks are much less abundant than laurel oaks but because of their large size and greater life span, they can sequester a great portion of CO_2 than other trees. Most of the trees on Figure 2 also are on the list of the ten most common trees found in Gainesville. For more information about common trees in Gainesville, read "Gainesville's Urban Forest Structure, Composition, Size, and Density," http://edis.ifas.ufl.edu/FR281).

Conclusion

Cities are a major source of carbon dioxide emissions. As demonstrated by this fact sheet, urban and natural trees can help mitigate the effects of climate change somewhat by sequestering CO_2. However, urban trees can only sequester a small portion of all carbon dioxide emitted from cities. In addition, decomposing trees and mulch; tree maintenance activities that use fossil-fuel-burning tools (e.g., chainsaws, leaf blowers, mowers, and cars and trucks); and improperly placed trees that cause shading in winter can also result in emissions of CO_2. It is important for communities to reduce fossil fuel emissions and manage for and preserve large, healthy trees to maximize the amount of CO_2 sequestered by an urban forest.

Literature Cited

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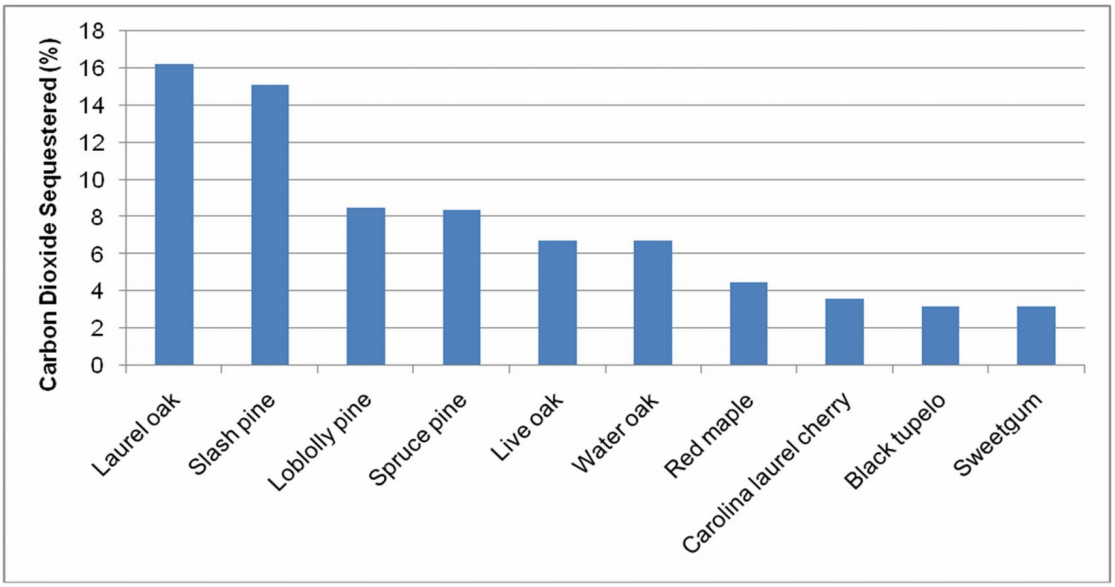

Figure 2. The ten tree species that sequester the most carbon dioxide (CO_2) in Gainesville, Florida (% of all CO_2 sequestered by Gainesville's urban tree population). Escobedo and Zipperer. 2007.